Space Weather Technical Forecast

Issued on Saturday, 05 February 2022 at 13:13 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares (R1/R2 Radio Blackouts) throughout. Chance of isolated G1/Minor Storm activity today (05 February).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: There are currently five numbered sunspot regions on the visible disc. Solar activity was low, with a number of C-class flares observed. The majority of the flares were from AR2936 Ehi/Beta, a large, complex and mature region nearing the northwestern limb. The largest flare was a long duration C5 flare, peaking at 04/1551 UTC. A CME was generated from this event, which has been analysed and shows it clearly missing Earth. AR2938 remains a small and simple group, but with some slight spot development. AR2939 in the southeast quadrant appears to be relatively stable, with only slight spot growth and remains classified as Cho/beta-gamma. AR2940 in the northeast quadrant, has developed further intermediate spots and remains a Eai/beta. AR2941 close to the northeast limb is currently classified as Ehi/beta, and is a potentially significant region. A new and unnumbered sunspot has developed to the south of AR2939, which is currently a small and stable Bxo/beta.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1, started the period at elevated levels, with a peak of 527km/s at 04/1347 UTC, due to the influence of the CME, which arrived on 01 February, before declining to slightly elevated levels from 04/2000 UTC to 05/0800 UTC, increasing to the current elevated conditions, with speeds currently between 500-550 km/s, probably due to connect with a HSS from CH49. Density was mainly average to slightly above average throughout the period, with a peak of 13ppcc at 04/2050 UTC. Total magnetic field strength was predominately Moderate, peaking at 11 nT at 04/1633 UTC, and currently remains Moderate. The all important Bz value was predominately negative, with a peak value of -10 nT at 04/1640 UTC. These observations suggest that the Earth was under the influence of the trailing magnetic cloud from the CME, which arrived on 01 February, with embedded structures resulting in the fluctuations of the solar wind parameters. Phi angle remained negative (towards the Sun). Geomagnetic activity was mostly Unsettled to Active (Kp 3-4), but with G1/Minor storm (Kp 5) conditions 04/1500-2100 UTC. Geomagnetic activity is currently at Quiet (Kp1-2) conditions, observed at 05/0600-1200 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 was at background levels. The high energy electron flux (greater than 2MeV), started at moderate levels, but after 04/1140 UTC dramatically increased to breach the High 1000 pfu value between 04/1320-1850 UTC, peaking at 4014 pfu at 04/1640 UTC, but remain at current Moderate levels. The associated 24-hour electron fluence remained below the Active threshold (1e8 integrated pfu), but with an increasing trend late in day and a value of 4.32e7 integrated pfu at 05/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mainly low, with a chance of M-class flares and a very slight chance of X-class flares.

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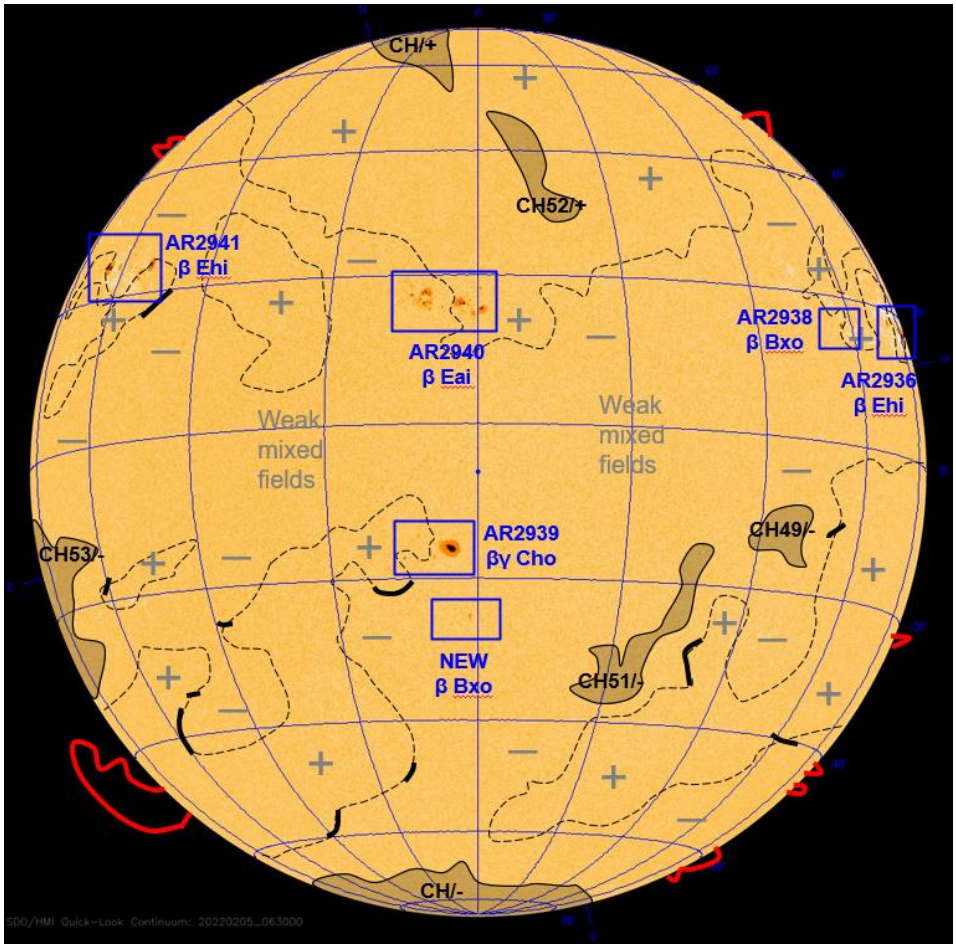
Met Office Space Weather Technical Forecast

Solar Wind / Geomagnetic Activity: Solar winds are currently increasing and are expected to be at elevated levels during today (05 Feb), due to connection with a coronal hole high speed stream (CH HSS), with speeds up to/between 500-550 km/s. A further CH HSS connection with similar speeds is then expected on day 2 (6th). Activity is expected to be Unsettled to Active (Kp 3-4) today, tomorrow and day 3 (7th) but with isolated G1/Minor Storm (Kp 5) intervals likely today (05 Feb), reducing to a chance tomorrow (06 Feb) and a slight chance for day 3 (07 Feb). Day 4 (08 Feb)) activity is expected to return to Quiet to Unsettled (Kp 1-3) conditions.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is forecast to be at background to moderate levels but with a slight chance of rising close to or just above the S1 level given any significant M-class flaring. High energy electron flux (greater than 2MeV) is expected to breach the High (1e3 pfu) threshold at times today, tomorrow and more frequently through day 3 (7th) then becoming predominantly High during day 4 (8th). Electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold today, then increasing to breach the Active threshold either tomorrow or more likely day 3 (7th).

Figure 1. Solar Analysis Valid 05/0630UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The effects of a CME which left the Sun on 29 January and arrived at Earth on 01 February will continue to decline through today (05 Feb), with the magnetic field strength currently weak. The high speed stream from coronal hole 49 is expected to connect with the Earth today (05 Feb) with speeds of 500-550 km/s likely, based on persistence data and analysis of STEREO A data, which is around 2.5 days ahead of Earth. This currently looks likely to be happening, with a steady rise in speeds to around 530 km/s.

A high speed stream from coronal hole 51 is then expected to connect with the Earth tomorrow (06 Feb), producing similar speeds. From day 3 (07 Feb) and especially day 4(08 Feb) the influence of the CH HSS will decline, with solar winds reaching background to slightly elevated values by late on day 4.

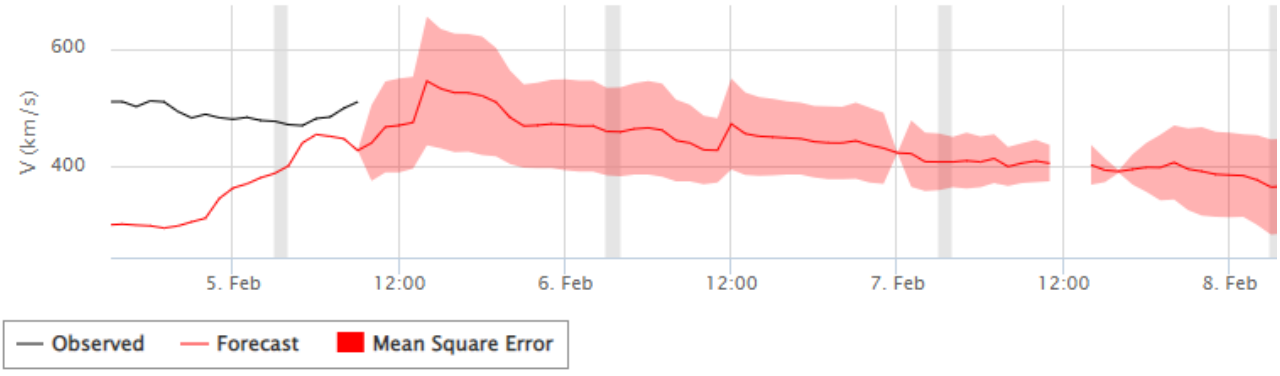
Activity is expected to be Unsettled to Active (Kp 3-4) today, tomorrow and day 3 (7th) but with isolated G1/Minor Storm (Kp 5) intervals likely today, reducing to a chance tomorrow and a slight chance for day 3. Day 4 (8th) activity is expected to return to Quiet to Unsettled (Kp 1-3) conditions.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	60	40	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Met Office Solar Wind Persistence Model – shows fast wind from coronal hole during today (05 Feb), with speeds up to 500-550km/s expected.



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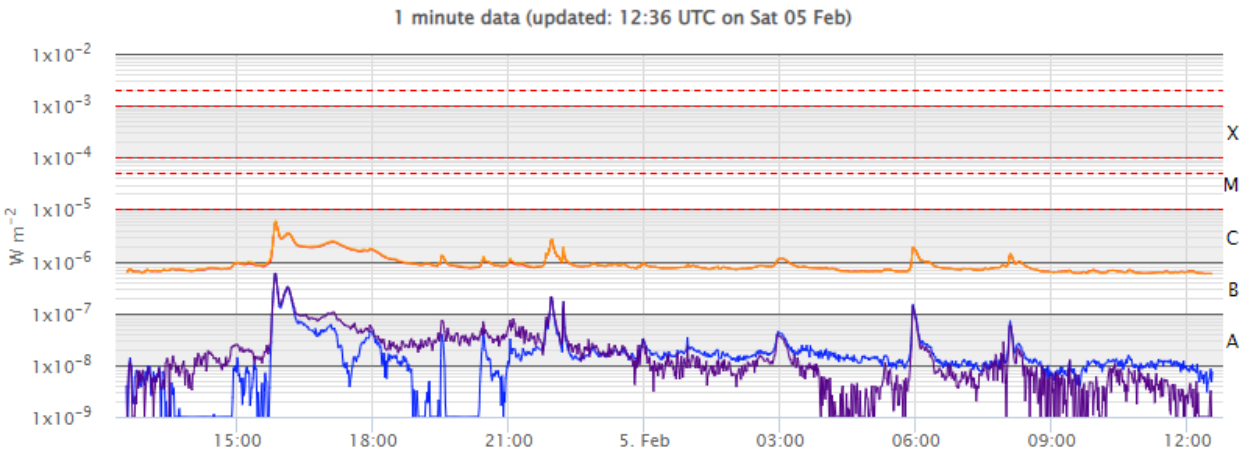
Radio Blackouts - X-Ray Flares:
Solar activity is expected to remain mainly low over the next four days, with a slight chance of M-class flares and a very low risk of X-class flaring.

There are four significant sunspot regions on the visible disc. AR2936 in the northwest quadrant, has become more active through the last 24-hours, following a relatively dormant period through the previous seven days, generating a long duration C5 flare yesterday. Two regions in the northwest quadrant 2940 and 2941 are classified Eai/Beta and Ehi/Beta respectively and present a significant flare risk. AR2939 in the southeast quadrant appears complex but stable and carries a lower risk of M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES-16 X-Ray Flares – past 24 hours.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux, as measured by GOES-16 is at background levels. Solar radiation storms are not likely in the period, however there is a slight chance (5%) for proton fluxes to rise given any significant flaring, predominately from AR2936 positioned in the northwest quadrant.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

Two high speed streams are due to connect with the Earth, one today (05 Feb) and another tomorrow (06 Feb), which are likely to further distort the radiation belts and redistribute electrons away from the belts. As associated geomagnetic activity declines, especially late in the period, there is an increasing chance of the high energy flux exceeding the High (1000 pfu) threshold, with generally High flux values possible through much of day 4 (8th).
Electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold today, then increasing to breach the Active threshold either tomorrow or more likely day 3 (07 Feb). Therefore the Met Office REFM model is considered to be giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	50	60	80
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	5

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Figure 4: REFM observations and forecast. Electron fluence shows increasing trend late in the period, probably exceeding the (1e8 integrated pfu) threshold.

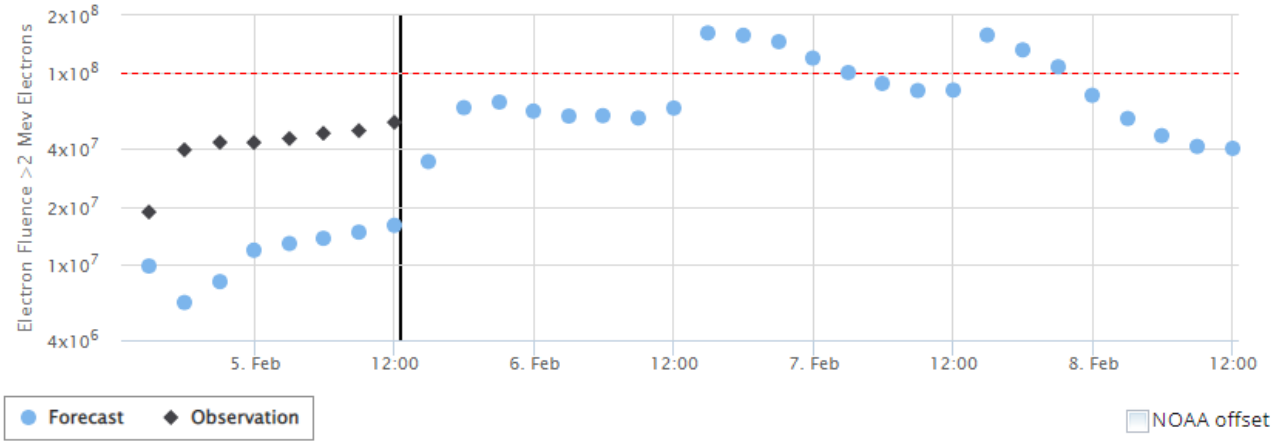
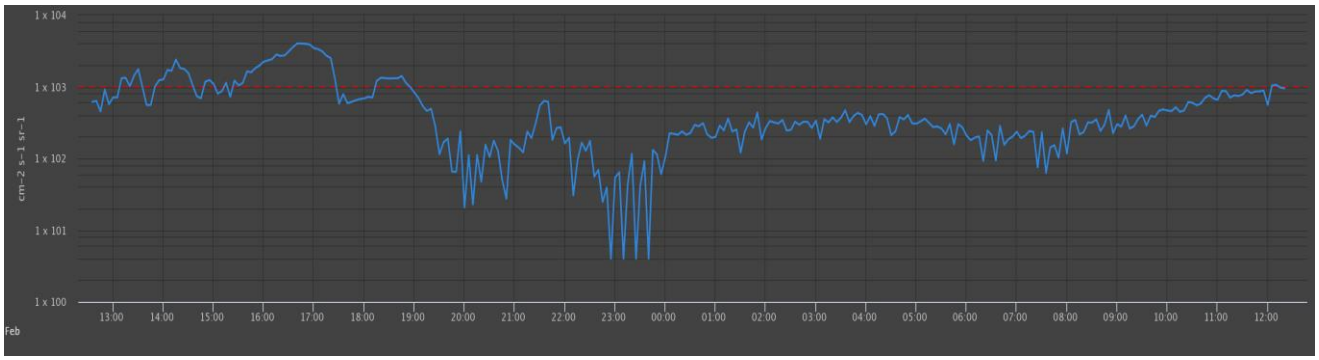


Figure 5 – GOES-16 Electron Flux – diurnal peaks at Moderate to High levels – exceeding >2Mev.



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